Understanding and Mitigating the Impacts of Agrochemicals

Pesticides, fertilizers, pharmaceuticals, microplastics, and other agrochemicals are used on farms and in other settings to manage pests and protect crop yield and quality. Despite important uses, agrochemicals can adversely impact human, animal, and environmental health when they leach or run off into soil and water or accumulate in non-target organisms.

Researchers from 20+ State Agricultural Experiment Stations are working to help farmers, government agencies, chemical manufacturers, and others make prudent decisions that reduce the adverse impacts of agrochemicals.

Project members are monitoring and characterizing the fate of agrochemicals in agricultural, urban, and natural areas; determining adverse impacts from agrochemical exposure to cells, organisms, and ecosystems; developing tools to mitigate the adverse impacts of agrochemicals.

The multistate approach has many benefits.

Long-term, interdisciplinary, multistate research makes it possible to understand agrochemical impacts across multiple scales in a way that no single institution or state can. Working together and with industry scientists, researchers can share ideas, knowledge, tools, and other resources to facilitate efficient, innovative research and productive collaborations. With members across the nation, findings can be shared widely. A large, diverse team and regular meetings also helps early career scientists develop long-lasting connections and skills that advance their careers.

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Research Highlights

Researchers developed tools to measure agrochemical contamination and toxicity. Studies also monitored the fate of agrochemicals and their impacts on the environment and non-target organisms. For example, researchers:

- Created a low-cost, minimally invasive sensor that can rapidly quantify multiple biomarkers associated with even very low pesticide exposures (Washington State University).
- Developed a simplified, low-cost way to monitor the toxicity of residual herbicides in ready-to-sell composts (Ohio State University).
- Used cutting-edge analytical and mapping tools to measure and model dispersal of pesticides at a regional scale.
- Measured pyrethroid use and levels of mosquito resistance in an urban area of Texas. (Texas A&M AgriLife Research)
- Found that seasonality and weather affect the occurrence, distribution, and loading rates of pesticides in watersheds (University of Kentucky).
- Assessed how salinity affects agrochemical fate and toxicity (Louisiana State University).
- Showed that urban use of pyrethroids can contaminate streams with hormone-disrupting chemicals (University of California).
- Shed light on how heavy metals make their way from soil and irrigation water into edible plants and animals (University of Nebraska).
- Identified which contaminants are most likely to accumulate in vegetables (University of California)
- Tested agricultural landscapes and found that pesticide levels had low potential for adverse effects on bees (Montana State University, Washington State University).
- Developed a sensitive fiber that can detect neonicotinoids in the nectar and sap of live, flowering plants (University of California).
- Showed that even low doses of PFAS could adversely affect eastern tiger salamanders (Purdue University).
- Showed that adverse effects of agrochemicals on fish in early life stages can persist through multiple generations (Oregon State University).
- Worked with members of the California Central Valley Regional Water Quality Control Board to better characterize the fate and effects of currently used pesticides as part of the state's Irrigated Lands Regulatory Monitoring Program.
- Collaborated with regional and international scientists and the California Waterboard to produce a plan for monitoring microplastics in drinking water (Oregon State University).

Scientists discovered new ways to remediate agrochemical contamination, including:

- Low-cost amendments to remediate herbicide-contaminated compost (Ohio State University).
- A patented cost-effective soil amendment to control concentrations of contaminants like arsenic in food crops (University of Nebraska).
- Innovative techniques to reduce glyphosate concentrations in storm run-off.
- Vegetative buffers to reduce pesticide concentrations in farmland runoff (University of Florida and the Center of Excellence in Regulatory Science in Agriculture).
- New ways to use glycerol to enhance the ability of the bacteria to biodegrade carcinogenic PAHs (University of Hawaii).

Project members shared outreach, education, and advice about agrochemicals to industry groups, policymakers, regulators, non-profits, and others. For example, they:

- Work closely with industry and non-profit associations (including the state agricultural commissions and commodity groups) to share findings about agrochemical use.
- Consult for non-governmental organizations like the Environmental Defense Fund.
- Serve on advisory panels for the Environmental Protection Agency. The U.S. Environmental Protection Agency used findings to create pesticide labels and set restrictions.
- Created the Center of Excellence in Regulatory Science in Agriculture, which collaborated with international colleagues on pesticide regulatory processes for the European Union and Latin America (North Carolina State University, Louisiana State University, University of Florida, and Bayer)
- Provided public outreach through the National Pesticide Information Center. This free, web-based resource provides objective, science-based information about pesticides, pesticide poisonings, toxicology, and environmental chemistry which enables people to make informed decisions.
- Housed the TOXicology NETwork, which is one of the most widely used websites for technical information on pesticides and household chemicals (Oregon State University).
- Produced numerous widely-cited publications. A recent Environmental Science & Technology publication received over 100 citations and was selected by the editors as the "best feature paper" in recognition of the quality and novelty of the work and its impact on the field. Another article was recognized by Wiley as a top cited paper in the Journal of Environmental Quality between January 2022 and December 2023.

This project was funded in part by the Multistate Research Fund through USDA-NIFA and by grants to project members at participating institutions: University of California-Davis, University of California-Riverside, University of Connecticut, Cornell University, University of Florida, University of Hawaii, University of Illinois, University of Kentucky, Louisiana State University, University of Maryland, University of Massachusetts, Michigan State University, University of Minnesota, University of Missouri, Montana State University, University of Nebraska-Lincoln, University of Nevada, Reno, North Carolina State University, Ohio State University, Oklahoma State University, Oregon State University, Purdue University, Rutgers University, South Dakota State University, Texas AgriLife Research, Virginia Tech, Washington State University, University of Wisconsin, USDA-ARS. **Learn more:** bit.ly/W4045

This Impact Statement was produced in 2024 by the Multistate Research Fund Impacts Program, which is supported by agInnovation, the State Agricultural Experiment Stations, and the Hatch Multistate Research Fund provided by the USDA NIFA. **Learn more:** mrfimpacts.org